

SEARCH FOR LARGE PRESOLAR SILICATE GRAINS IN THE QUE 99177 CR CHONDRITE.

A. N. Nguyen^{1,2} and S. Messenger¹. ¹Robert M. Walker Laboratory for Space Science, ARES, NASA JSC, Houston TX, (lananh.n.nguyen@nasa.gov). ²ESCG/Jacobs Technology, Houston, TX

Introduction: Silicates are among the most abundant presolar grain type, and their diverse chemical and isotopic compositions preserve detailed constraints on their stellar origins, condensation conditions, and nucleosynthetic and interstellar processes. Yet, owing to their small sizes, relatively few grains have been measured for isotopic compositions besides O and Si [1-7], and their mineralogy is poorly characterized. The average grain size (~270 nm) limits the number of analyses that can be conducted on a given grain, and their identification among solar system silicates introduces contaminating signal. These difficulties can be overcome by identifying large presolar silicate grains. However, such grains are very rare and only two ~1 μm grains have been discovered [8,9]. We are conducting a dedicated search for large presolar silicates in size-separated QUE 99177 matrix material. This primitive meteorite has among the highest abundance of presolar silicates [10].

Experimental: A grain size separate of QUE 99177 matrix was produced by gentle freeze-thaw disaggregation and ultrasonication. Organic matter was then removed by refluxing the matrix in toluene and methanol. Silicate grains nominally 1-2 μm in size were isolated by centrifugation in a solution of isopropanol and water. These grains were distributed on Au foil and relatively dense regions were chosen for analysis by ion imaging in the NanoSIMS 50L. To accelerate the search, we used an elevated Cs^+ primary beam current of ~2 pA Cs^+ that resulted in moderately degraded spatial resolution (~200 nm). We acquired images from 20 μm fields of view and the isotopes of O, Si, and $^{24}\text{Mg}^{16}\text{O}$ were simultaneously measured. 256×256 pixel images were generated for each region with integration times ranging between 1.5-2 hours.

Results and Discussion: We have analyzed a total of 327 regions so far, spanning an area of ~40,000 μm^2 and an estimated 950,260 grains. Although organics were removed from the sample to prevent grain aggregation and to provide a better size separation, most of the grains were smaller than 500 nm. Nine anomalous grains were identified, two of which are probable oxides. The presolar grains range from 200–300 nm in size. Their O isotopic compositions are consistent with condensation in low-mass AGB stars, with ^{17}O enrichments up to 800%, with the exception of one ^{18}O -rich silicate that likely originated in a supernova. Because a larger primary ion beam was used, measured ratios are diluted and very small or less anomalous grains were likely missed. Further searches on improved size separated matrix residues are planned.

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